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FISHERY RESEARCH

# 1991-92 FISHERY RESEARCH FINDINGS

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**KOOTENAI RIVER WHITE STURGEON INVESTIGATIONS AND EXPERIMENTAL CULTURE**

*Kimberly A. Apperson*
*Senior Fishery Research Biologist*

**Evidence of recruitment of juvenile sturgeon in the Kootenai River is virtually nonexistent.** A sample of 374 fish collected from 1989 through 1991 included only seven sturgeon that were younger than the 1972 year class, when Libby Dam began operating.

A 16-inch shift toward larger fish was observed in samples collected over the past 10 years. A comparison of population estimates made in 1982 and 1990 show a decline in number of fish from 1,194 to 880. **Virtually the entire population is comprised of reproductively mature and maturing sturgeon.**

Estimate of annual mortality is 0.03 to 0.06 for this population of adult fish. Approximately 7% of the female sturgeon in the Kootenai are reproductive each year; 30% of the males are reproductive each year. With a 1:1 sex ratio, this means 22 to 42 females may attempt to spawn each year; and 96 to 182 males may attempt to spawn. **With zero recruitment of juveniles into the population, the number of Kootenai River white sturgeon may decline to less than 100 individuals within 30 years.** A manipulation in the regulated discharge through Libby Dam toward more natural spring flows may enhance sturgeon reproduction in the Kootenai.

In both 1990 and 1991, unusually high water years, movements of reproductively mature sturgeon were observed by telemetry. Increases in discharge to the lower river were associated with upriver migration and congregations of several fish in higher velocity areas. In early July, 1991 a dozen fertilized sturgeon eggs were recovered from artificial substrate at Bonners Ferry.

Successful culture of Kootenai white sturgeon has shown that, although several contaminants are found in eggs, this population is viable and capable of recovery. The Kootenai sturgeon hatchery is capable of limited production of sturgeon and will serve the purpose of maintaining management options by providing some year classes of sturgeon until natural recruitment is resumed. We will also be able to attain some understanding of the habitat needs and preferences of juvenile sturgeon.

Supplementation of sturgeon from the Kootenai Hatchery will not substitute for natural recovery of the wild population. Eggs from only one or two wild females can be practically taken each year; and fertilized with milt from up to three males. A culture operation with this small of a supply of brood stock simply cannot maintain the genetic integrity of this population. The Kootenai population is genetically distinguishable from lower basin stocks, and displays a reduced polymorphism and heterozygosity in several enzyme systems.

*Funding Source: Bonneville Power Administration*

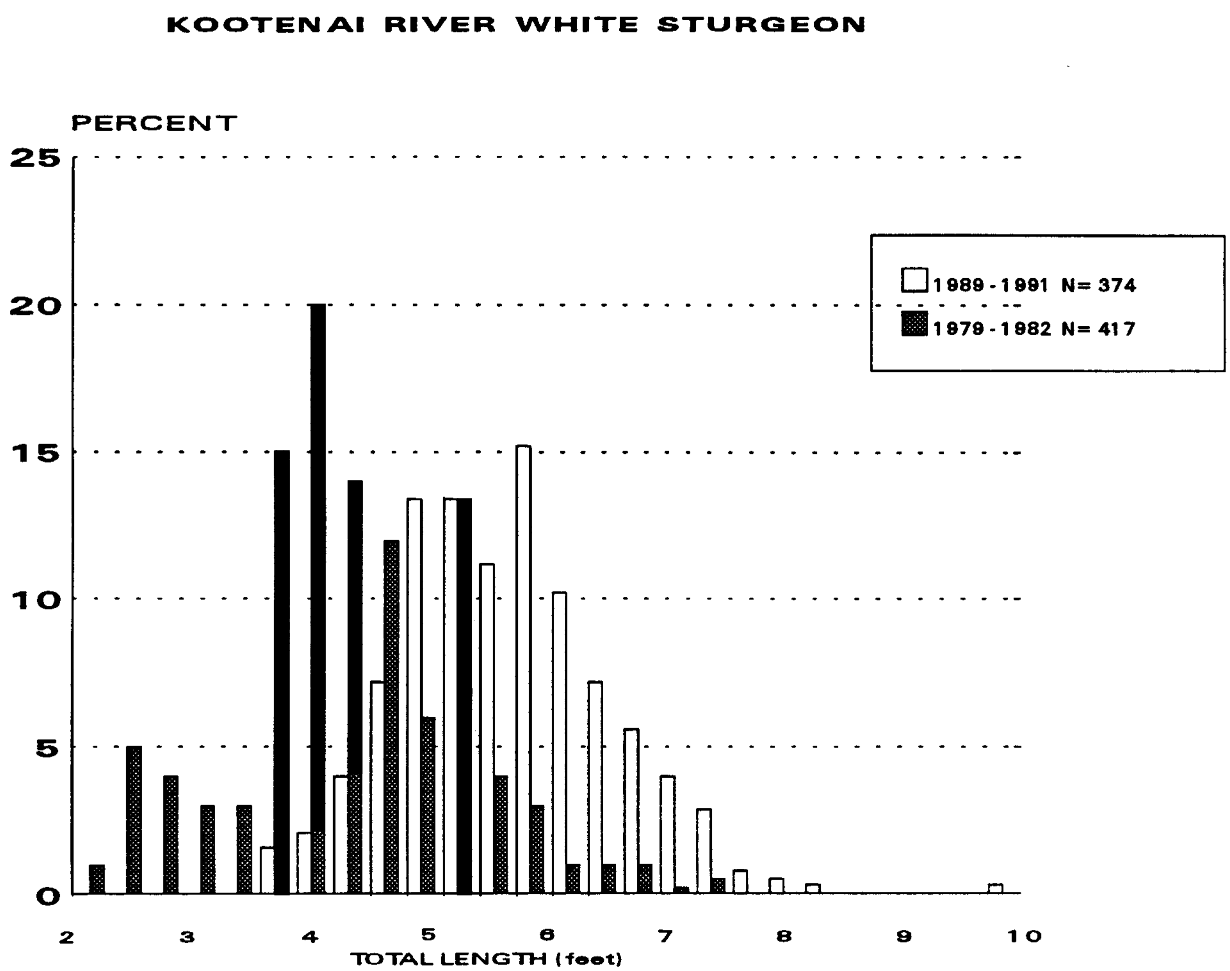



*Figure 1.*

**KOKANEE STOCK STATUS AND CONTRIBUTION OF CABINET GORGE HATCHERY, LAKE PEND OREILLE, IDAHO: 36819, BPA Project 85-339**

*Vaughn L. Paragamian*
*Senior Fishery Research Biologist*

Anglers fished over 460,000 hours during 1991 and caught about 227,000 kokanee, 2,157 Gerrard Rainbow trout, 1,723 bull trout, and 766 cutthroat trout. This harvest of kokanee is only 33% of the goal but substantially improved from 1985. The harvest of large rainbows was the best in 15 years.

This improvement in Kokanee fishing is the result of initial increasing success, Kokanee abundance to 10.2 million fish in 1988. However, a continuous decline since then has resulted in 47% fewer Kokanee in 1991 (5.4 million fish). This decrease was attributed to poor recruitment of wild fish, poor egg take at Sullivan Springs, and the failure of adults to return to the Cabinet Gorge Fish Hatchery. The result has been lower numbers of hatchery fish to stock, only 5.1 million in 1991 compared to over 13.0 million in 1988.

**Kokanee fry released from Cabinet Gorge Hatchery during 1991 comprised 59% of the total number of fry in Lake Pend Oreille, while wild fish contributed only 41%, a lower proportion than previous years** (Figure 1). But hatchery fry abundance in 1991 was lower than the previous two years because only 5.1 million fry were released compared to an average of 8.0 million. Hatchery fry survival of 21% in 1991 is similar to 1990 and 1989, but all years were lower than 1988. The goal is to achieve 30% survival and was nearly reached in 1988 (29%).

*Funding Source: BPA, Washington Power, Wallop Breaux*

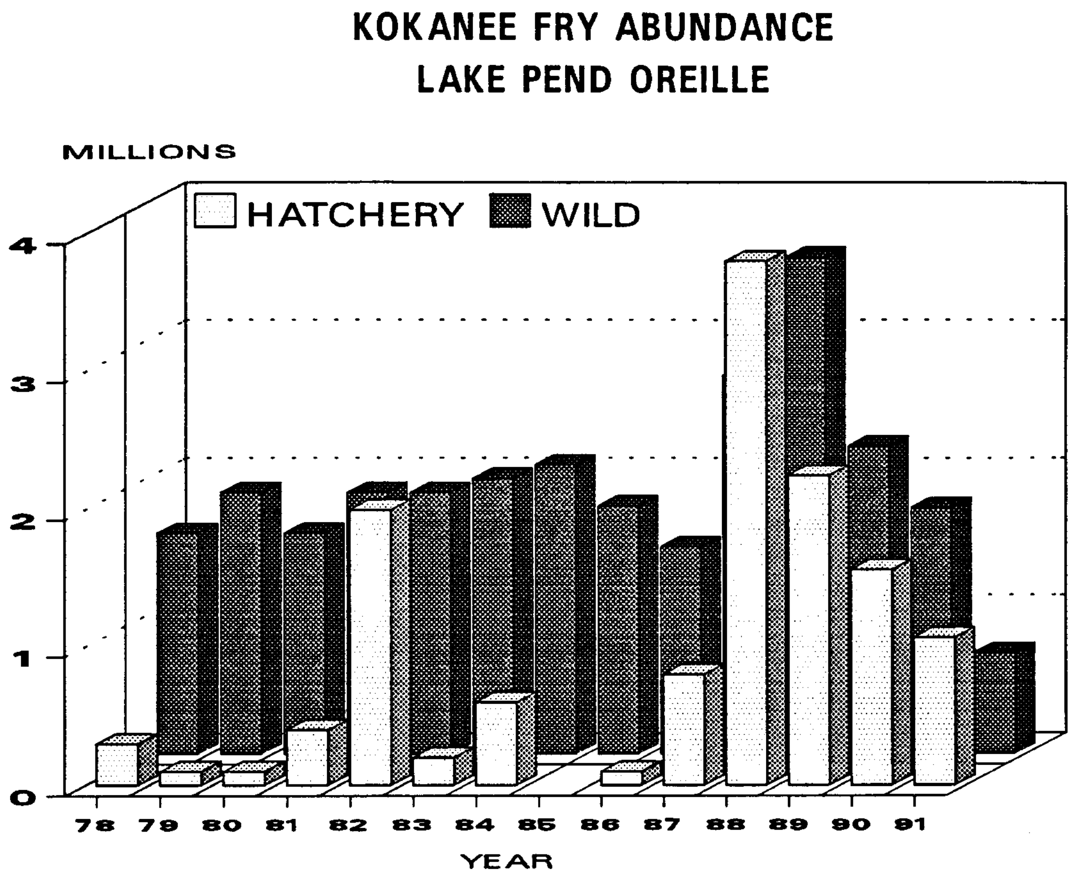



*Figure 2.* *Total abundance of wild and hatchery-reared kokanee fry in Lake Pend Oreille, Idaho, during late summer 1978 through 1991. Hatchery contribution in 1985 was not estimated.*

**KOKANEE MONITORING**

*Bruce Rieman*
*Fishery Research Biologist*

**The goal of the project has been to develop the technology, equipment, and methods to support a long-term monitoring and adaptive management program for lake and reservoir populations of kokanee.**

In 1991, we completed development of a new portable trawl boat. We used the new boat to make population estimates on eight lakes or reservoirs in Southern Idaho. Four estimates were for the first-time, on waters that could not be accessed with the larger trawl boats (Alturas, Redfish, Deadwood, and Lucky Peak). At least four more lakes can be added to the monitoring program in the future.

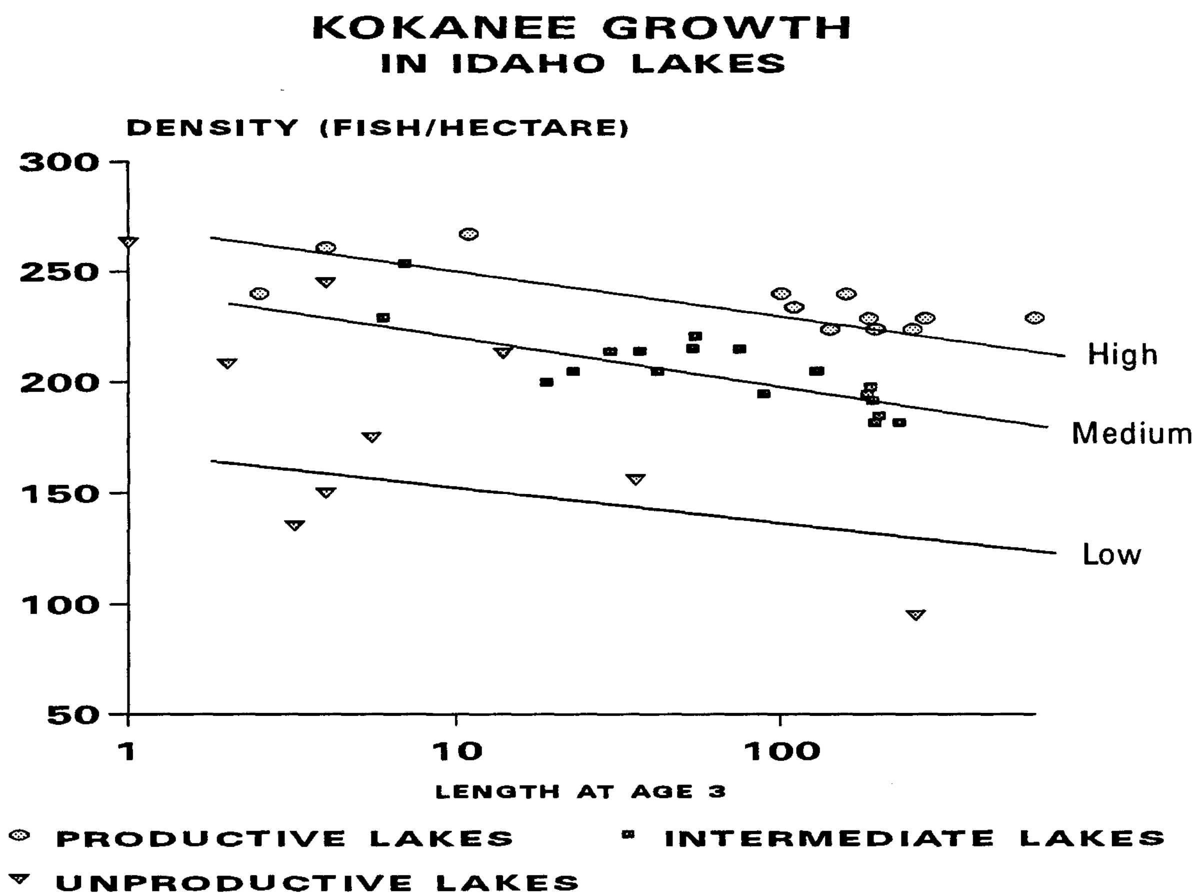
Data from the sampling were used to refine existing models of kokanee growth and carrying capacity. Those models allow fishery managers to predict the relative change in fish size, and potential yield with manipulations of the population. The data also provide regional fishery managers with some perspective on the status of their populations and fisheries and identified populations that may be at risk.

We are also working on guidelines for a consistent long-term monitoring program. The guidelines will provide detailed methods for data collection and a standard format for reporting.

We will also provide the background for interpretation and application of results. The intent is to develop a consistent and coordinated monitoring program that can be turned over to the regions and maintained with a limited cost in time, or money. A consistent monitoring program maintained among a large number of fisheries will provide the most powerful information for research and solid base for adaptive management.

Our methods and data base have proven extremely useful in current kokanee management. The British Columbia Fishery branch has begun collecting comparable data to help guide their own programs.

*Funding Source: IDFG with Wallop Beaux*



KOKANEE GROWTH
IN IDAHO LAKES
DENSITY (FISH/HECTARE)
300
250
200
150
100
50
1
10
100
LENGTH AT AGE 3
High
Medium
Low
PRODUCTIVE LAKES
INTERMEDIATE LAKES
UNPRODUCTIVE LAKES


*Figure 3.*

## KOKANEE MODELS PROJECT

*Bruce Rieman*
*Fishery Research Biologist*

*Deborah Myers*
*Senior Fishery Technician*

Lake trout, chinook salmon, rainbow trout, and Atlantic salmon have been frequently stocked in kokanee lakes to support or develop trophy fisheries. The appropriate stocking rates and associated risks with predator management in kokanee lakes are poorly understood. We used existing information on life history characteristics, population dynamics, and feeding efficiencies to estimate yields and consumption of kokanee by introduced populations of lake trout and chinook salmon using kokanee biomass and lake productivity lakes was estimated. These results demonstrate the costs (lost kokanee production), benefits (predator numbers), and risks (possibility of kokanee population collapse), of predator management.

Our findings include the following:

1. Kokanee production and predator yields range about 10 fold for Idaho lakes. Lake productivity has a major influence on the quality of a fishery and should be considered before introducing predators. Because a 10 pound predator in the creel requires from 50 to 200 pounds of kokanee to produce, predators are not well suited to unproductive lakes.

2. Lake trout provide a better benefit to cost than chinook salmon in lakes where other fish besides kokanee are available as prey.

3. Lake trout are more likely to collapse kokanee population than chinook salmon in unproductive lakes or in lakes where kokanee numbers are variable.

4. Atlantic salmon and rainbow trout should provide benefits similar to lake trout, but represent less risk.

5. Appropriate stocking rates for most predators are from less than 2 to about 17 fingerling per acre of lake surface area. Historic stocking rates have been much higher in Idaho lakes and may explain the poor results of predator introduction and loss of Kokanee fishery (i.e. Anderson Ranch Reservoir).

These results can be used to predict appropriate stocking rates where predators are used and if they should be used.

*Funding Source: IDFG with Wallop Breaux*

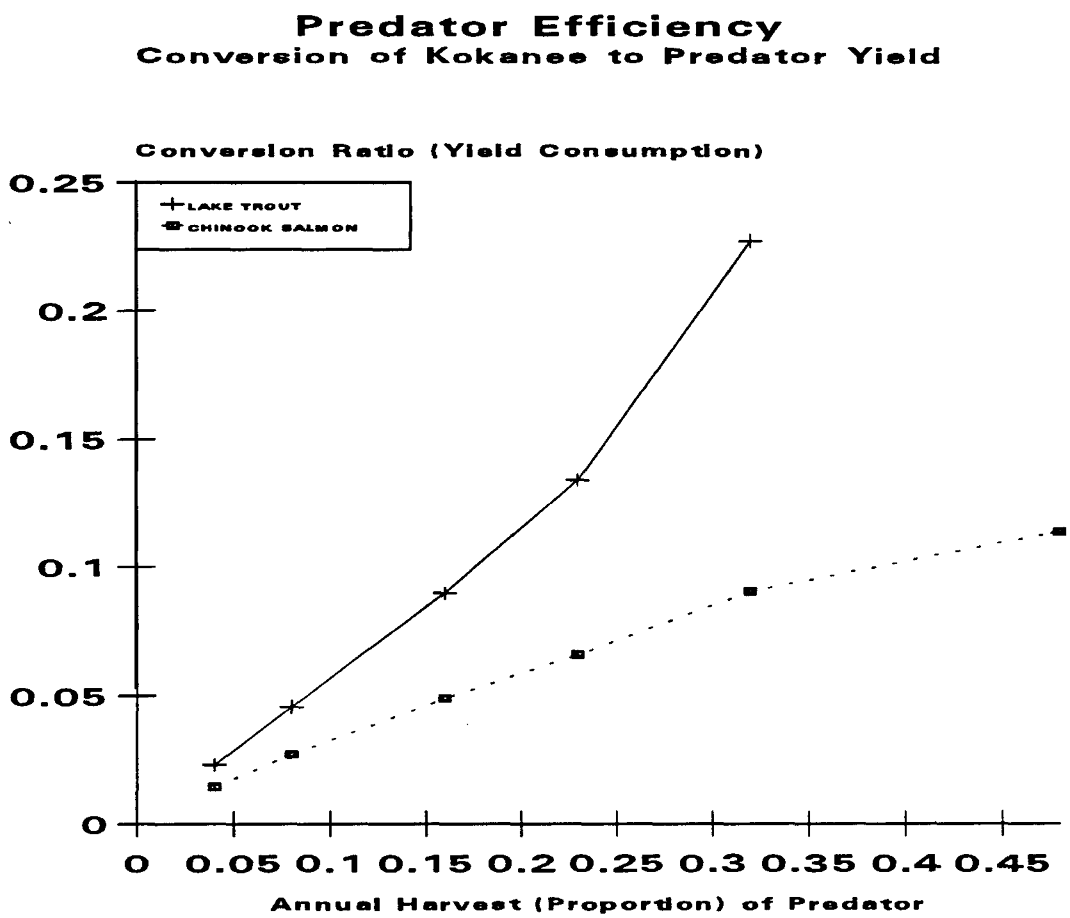
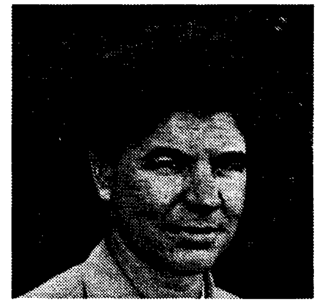

Predator Efficiency
Conversion of Kokanee to Predator Yield
Conversion Ratio (Yield Consumption)
0.25
0.2
0.15
0.1
0.05
0
LAKE TROUT
CHINOOK SALMON
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45
Annual Harvest (Proportion) of Predator

*Figure 4.*

# DWORSHAK DAM IMPACT ASSESSMENT AND FISHERY INVESTIGATION



*Melo A. Maiolie, Principal Fishery Research Biologist*

*Steve Elam, Senior Fishery Technician*

In 1987, the Bonneville Power Administration funded two 4-year research projects on Dworshak Reservoir. The purpose was to develop recommendations for improving the sport fishery and to evaluate the effect of dam operation on reservoir productivity. The program was a cooperative effort between the Idaho Department of Fish and Game and the Nez Perce Tribe. The Tribe examined smallmouth bass and the trout fishery. The Department checked the kokanee fishery and ability of the reservoir to produce fish.

The Department introduced kokanee into Dworshak in 1972. They are now self-supporting, spawning in tributaries, and support about 90% of the fishing pressure on the reservoir. The kokanee fishery declined during our study from a harvest of 206,000 kokanee and a catch rate of 1.5 fish/hour in 1988 to 95,000 kokanee at a catch rate of 0.8 fish/hour in 1990. Limited studies in 1991 indicated a further decline in catch rates to 0.5 fish/hour. Changes in the kokanee fishery reflected population changes in the reservoir. Mid-water trawling in 1989 indicated the reservoir contained 13 kokanee of harvestable size per acre, but that dropped to 2 kokanee per acre in 1991.

Angler satisfaction also declined throughout the study from 37% rating the fishery as poor in 1988, to 55% giving it a poor rating in 1990. Nearly all anglers cited low numbers of fish caught as the reason for the rating. Management goals of more numerous but slightly smaller kokanee, might maximize angler satisfaction.

Dworshak kokanee have exceedingly low annual survival rates; much lower than any kokanee populations. Over 80% of yearling kokanee died before recruiting to the fishery the following year. Losses of 83,000 to 235,000 kokanee annually through Dworshak Dam appeared responsible for the high mortality rates and the observed declines in the kokanee fishery. The resulting low densities reduced catch rates from 1.5 to 0.5 fish/hour and likely reduced fishing effort by 66%. Number of kokanee in tributary spawner counts (and in the reservoir) have declined with increased discharge through Dworshak Dam

(Figure 5). The greater the amount of discharge through the dam for a given year the lower the next years spawner count. Mostly two-year old kokanee are lost through the dam thus explaining the one-year lag time from discharge to spawner counts. In years of low kokanee losses through Dworshak Dam, this kokanee fishery is rated as one of the State's best.

Low kokanee density has, however, triggered good growth rates. Kokanee averaged 11 inches by July of their third summer in the reservoir. This compared to 7.5 inches in Coeur d'Alene Lake, and 8.3 inches in Lake Pend Oreille. Kokanee in these other lakes lived to be one to three years older than Dworshak Reservoir kokanee were ultimately similar in length.

*Funding Source: Bonneville Power Administration*

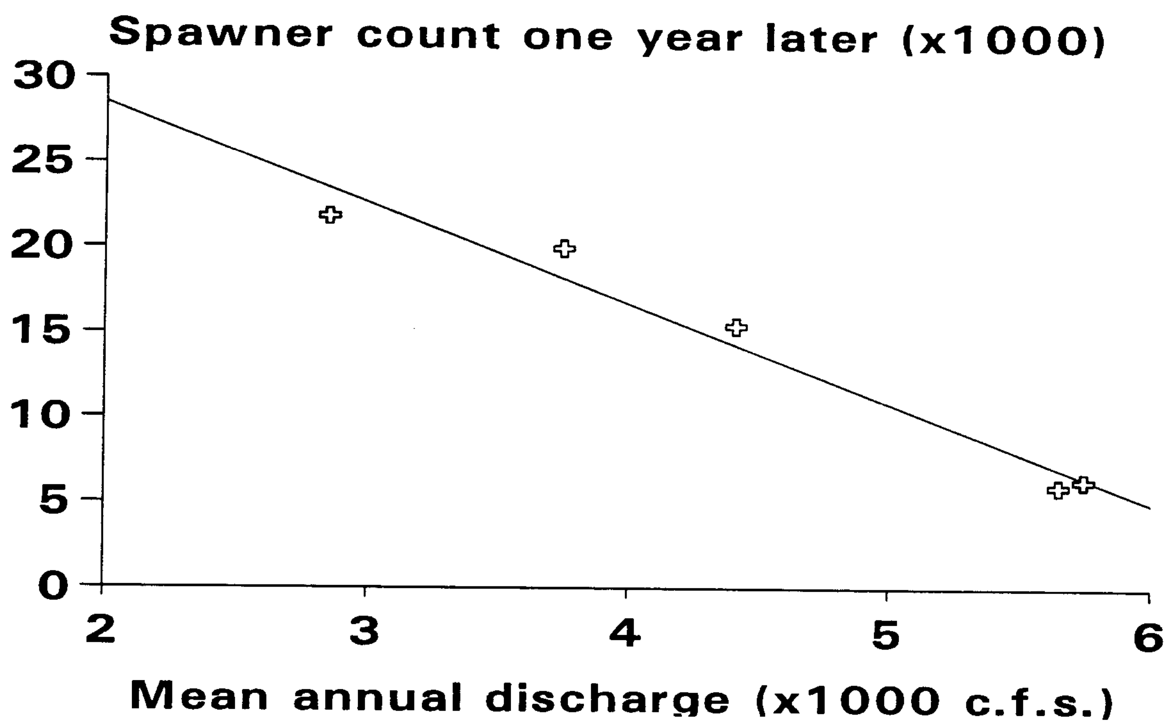



*Figure 5. Reduction of Kokanee spawners in relation to increased discharge from Dworshak Dam.*

## HATCHERY TROUT EVALUATIONS

*Gregg Mauser*
*Senior Fishery Research Biologist*

The major 1991 hatchery trout research objective was to develop stocking relationships for rainbow trout and evaluate ways for increasing return of stocked fish to the angler.

To test methods for increasing returns and maintaining catch rates, we tested harvest of large and small stocked rainbow trout in Rock Creek south of Twin Falls. Fish 11-16 inches in length were creeled twice as often as 6-11 inch hatchery rainbow. Up to 80% of the large rainbow were harvested. Each large trout cost $1.66 in the creel compared to $.54 for small trout.

However, large trout are cheaper per pound ($1.50) compared to small trout ($2.55). Hatchery rainbow made up 88% of the harvest of 3,717 trout from the upper 15 miles of Rock Creek. Fishermen harvested 50% of the hatchery rainbow stocked and volunteered lots of compliments of the larger trout.

Relationships from creel census data for Idaho streams show rainbow trout should be stocked at rates under two fish per angler hour in waters managed for put-and-take fishing (Figure 6). To achieve the goal of 30-40% return to the creel. This will result in lower catch rates.

*Funding Source: IDFG with Wallop Breaux*

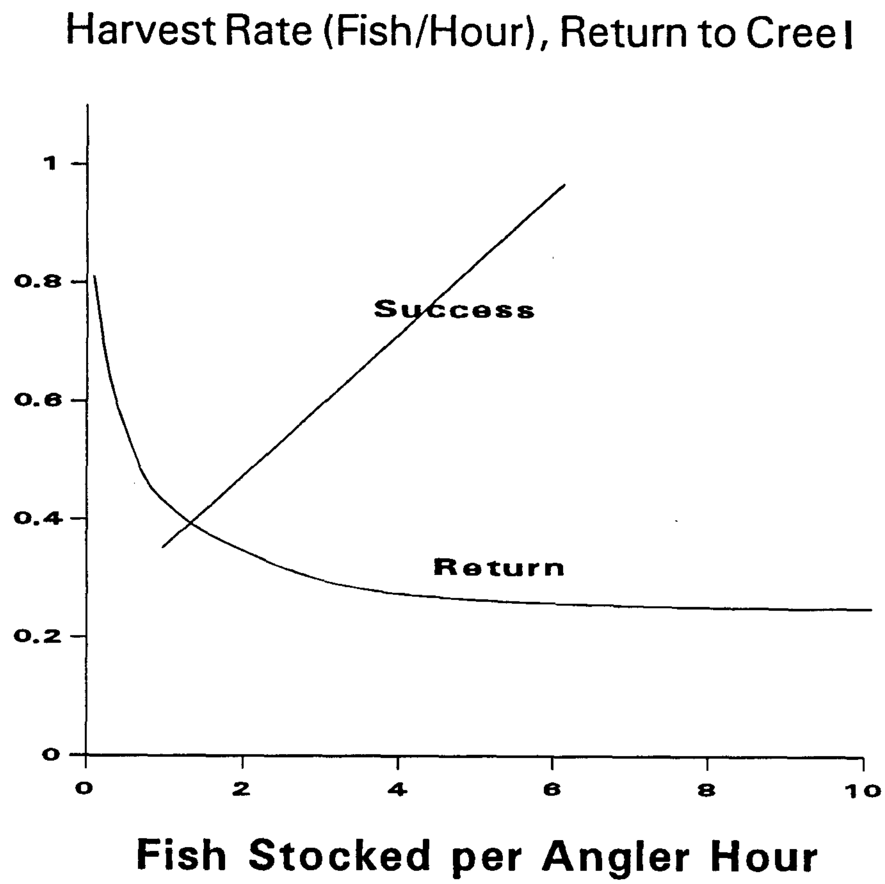



*Figure 6. Relationship between angler success rate, proportion of stocked fish harvested, and stocking per angler hour for rainbow trout in put-and-take fisheries in Idaho.*

## WILD TROUT RESEARCH

*Dan Schill*
*Principal Fishery Research Biologist*

The major objective of the wild trout research this year was to summarize existing creel census data to provide a better perspective on our wild trout fisheries. Areal estimates of effort (hours/acre) are better than linear use estimates (hours/mile) because they provide the amount of fishing pressure an individual fish is likely to receive. During the past decade, estimates of fishing effort on Idaho rainbow trout streams ranged from 36 to 2,743 hours/acre of fishable water on the Lochsa River and Silver Creek, respectively (Figure 1). The annual level of use for Silver Creek was five times greater than that for the Clearwater steelhead fishery below Orofino. Levels of fishing on Idaho special regulation waters are well below levels reported in other states.

A second objective on the statewide evaluation of electrofishing data demonstrated size selection commonly occurs in our large river population studies. Large fish (12-16 inches) were three times more likely to be sampled as smaller fish (5-12 inches). Failure to correct data for this selection results in serious underestimates of fish numbers and can lead to optimistic conclusions about the status of the population.

A third objective was to estimate bait-hooking mortality for wild rainbow trout in an Idaho stream and to confirm findings from past hatchery studies suggesting major benefits from cutting the line on deep-hooked fish. Bait hooking mortality for 281 wild trout was 16%. The incidence of deep-hooking was related to habitat type where the fish was caught. Cutting the line on deep-hooked fish increased survival of deep-hooked fish by nearly 60% and two thirds of survivors shed hooks within 4-5 weeks. Results suggest that rates of release mortality reported for bait-caught fish in hatchery studies (typically 30-50%) may not always be applicable to wild trout fisheries.

A fourth objective was to summarize existing bull trout information for a variety of Idaho waters to assess the status of this species. Bull trout numbers in 43 anadromous waters monitored continuously since 1985 have declined 3-fold since then. However, the number of fish spawning in Rapid River during 1991 was among the highest recorded since 1972. Statewide status of the species remains unknown.

*Funding Source: IDFG with Wallop Breaux*

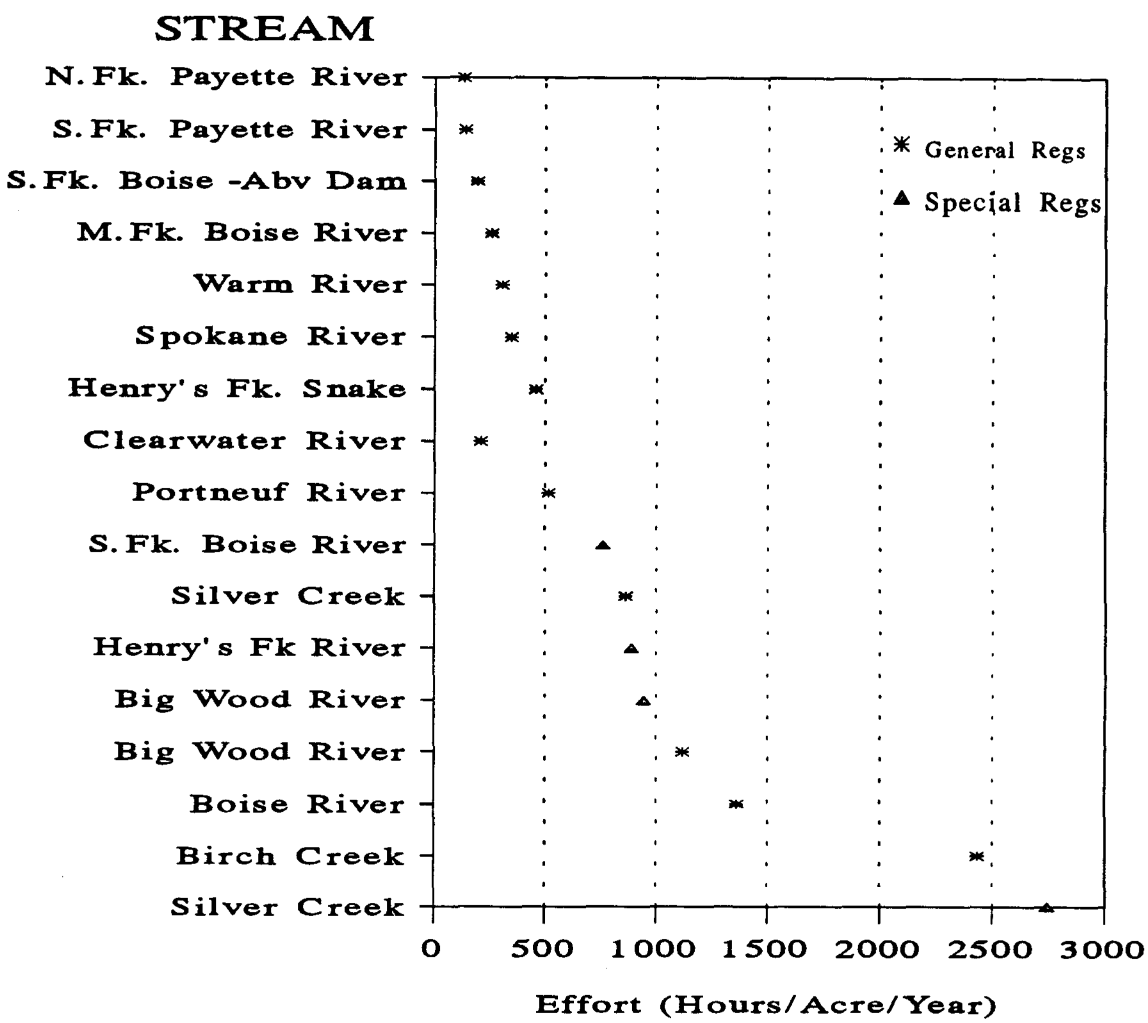



*Figure 7. Estimated annual angler effort (hours/acre/year) for wild rainbow trout fisheries in Idaho.*

## FORAGE FISH RESEARCH PROJECT

*Jeff Dillon, Senior Fishery Research Biologist*

We continued statewide work on largemouth bass fisheries with 1991 objectives to describe the range of largemouth bass densities and to assess the effects of minimum length limits on largemouth abundance, growth and average size. We made population estimates on eight waters, and included previous estimates from another eight. Idaho largemouth bass densities ranged from about 2 to 130 fish/acre. Most (75%) of our populations were below 40 fish per acre. Biomass ranged from 2 to 100 pounds per acre, with most (60%) below 10 pounds per acre. Largemouth densities in Idaho are lower than in reservoirs and ponds in other states, and densities in the lateral lakes are among the lowest reported in the country. Bass density had no influence on growth, suggesting that most populations are below carrying capacity, probably due to irregular reproductive success. Minimum length limits have increased average size but not numbers of largemouth bass in Thompson Lake, and there was no evidence of population buildups and stunting due to minimum length limits. Minimum length limits should continue to be the primary regulation to improve average size in Idaho largemouth bass populations. Irregular reproduction may make it difficult to provide consistency in our bass fisheries.

The statewide inventory of smallmouth bass populations objectives were to describe the range of smallmouth growth in Idaho, and the factors affecting growth. We collected data on twelve waters in 1991. Smallmouth bass generally took four to five years to reach 12 inches and seven to eight years to reach 16 inches. The range of growth was much smaller than that observed for largemouth bass in Idaho. Growth in most Idaho populations is near the predicted maximum given the temperatures of our waters, but forage may be limiting in some populations such as Dworshak. Most of the difference in growth among populations is due to differences in water temperature cycles such as Anderson Ranch. Forage introductions would not be expected to benefit these populations.

*Funding: IDFG with Wallop-Breaux*

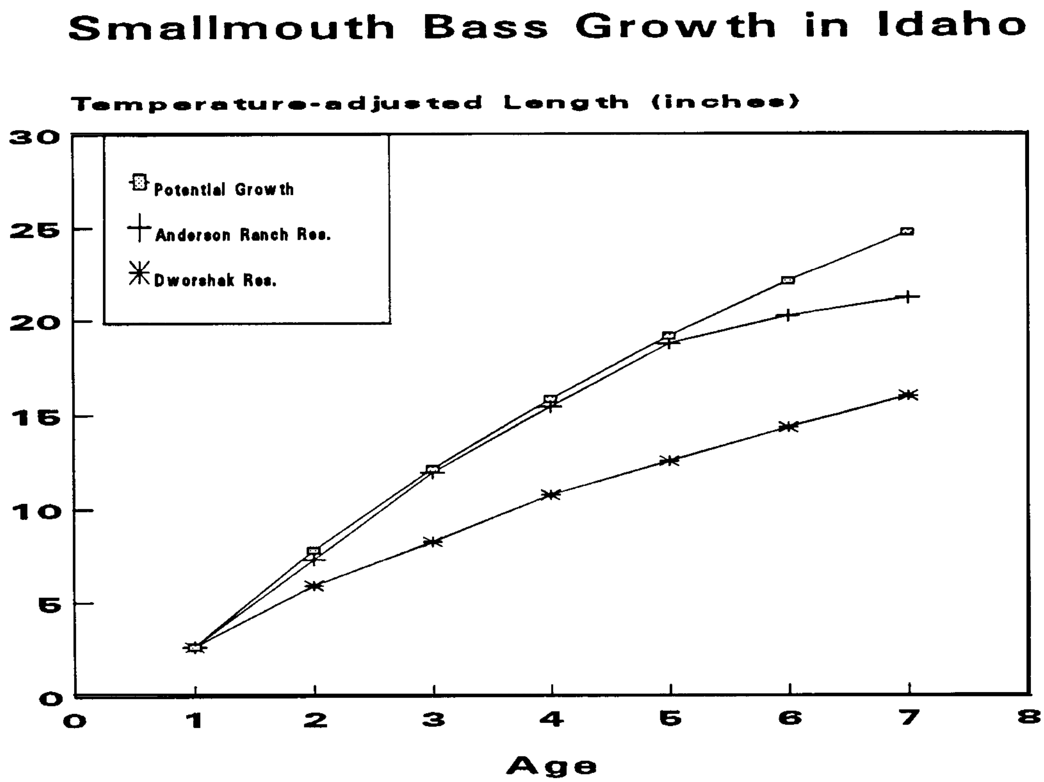



*Figure 8.* *After taking temperature into account, smallmouth bass growth in most Idaho populations approaches the maximum for the species (as in Anderson Ranch above). A few populations, including in Dworshak, showed signs of forage limitations.*

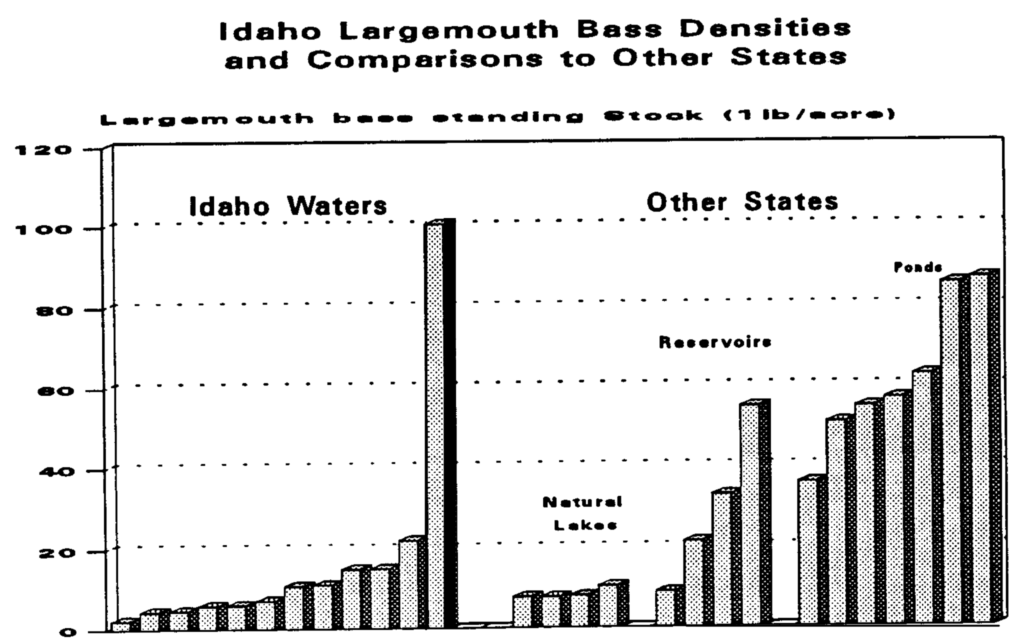



*Figure 9.* *Largemouth Bass densities in most Idaho populations are low compared to reservoirs and ponds in other states.*

## SOUTH FORK SNAKE RIVER WINTER HABITAT STUDY

*William C. Schrader*
*Senior Fishery Research Biologist*

Since the winter of 1986-87, drought has plagued the South Fork drainage, winter flows have been unusually low, and trout recruitment has nearly collapsed. Flows in the South Fork are regulated at Palisades Dam primarily for irrigation needs. In order to fill the reservoir during the drought, minimum winter flows have ranged from 750 to 1200 cfs. But juvenile trout have also decreased 70 to 90% compared to pre-drought estimates. Although these reductions appear to be flow-related, collapse of the trophy trout fishery in the South Fork has not yet materialized.

The goals and objectives of the South Fork Snake River research are to determine the winter habitat needs of juvenile fish and relate these needs to flows released at the dam. These results will be used to determine an instream flow during winter. The study has been completed, and the Final Report will be published by summer, 1992.

Winter habitats used by juvenile cutthroat trout and brown trout below the dam showed subyearling trout were most abundant in side channels and were closely associated with cover. They also used shallow, slow water. Whitefish differed from trout by being less dependent on cover. Few fish were observed during the day, indicating they used substrate at that time.

Flow/habitat relationships showed that habitat decreases with discharge during the winter, but not at a constant rate (Figure 10). The greatest rate of decrease for each species occurred between 1,540 and 1,240 cfs. There was not a great reduction of habitat between 1,240 and 830 cfs. Of the habitat available to subyearling cutthroat trout at 3,370 cfs, one-third was lost as flows were reduced to 1,540 cfs and over half was lost at 1,240 cfs. For brown trout, about half was lost at 1,540 cfs and two-thirds at 1,240 cfs. And for mountain whitefish, over half was lost at 1,540 cfs and three-fourths at 1,240 cfs. Although not directly comparable, these results concur with aerial photo work done in 1988; their results showed that more than half of upriver side channel areas were lost when flows were reduced from 2,200 to 750 cfs.

*Funding: U.S. Bureau of Reclamation*

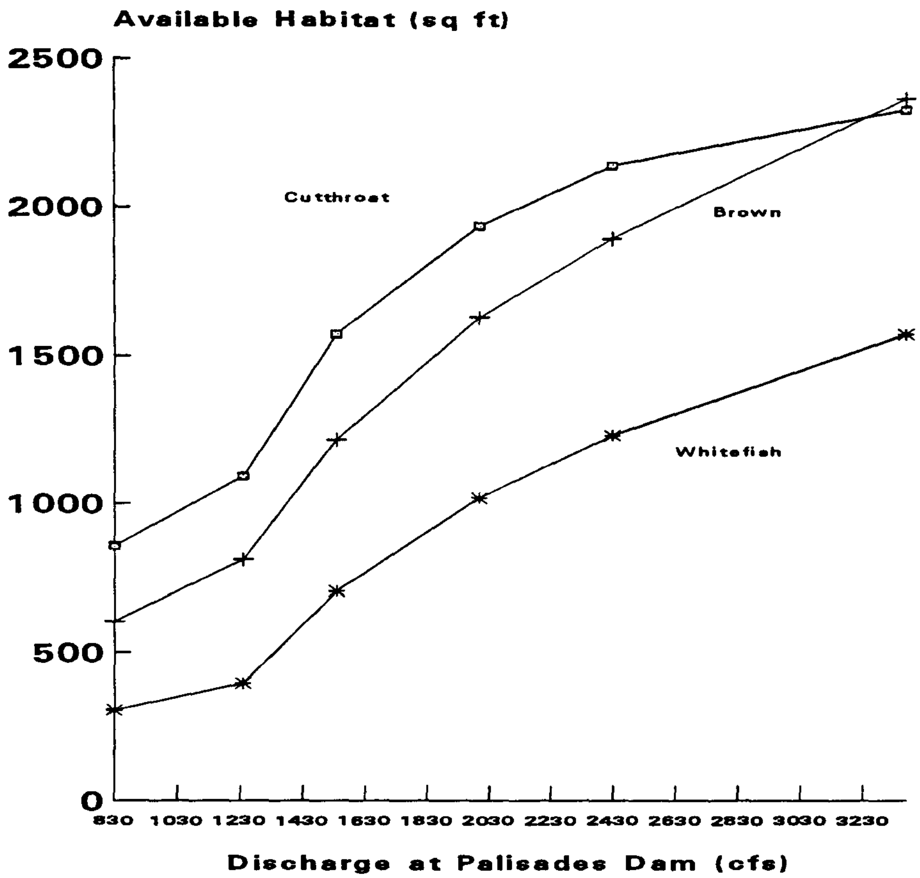



*Figure 10. Relationships of available habitat with discharge in the South Fork Snake river during winter. Differences between species are due to different habitat requirements.*

# HATCHERY EVALUATIONS STUDY - IDAHO

*David A. Cannamela*
*Senior Fishery Research Biologist*

The purpose of this research is to evaluate hatchery rearing and release strategies to improve adult returns of anadromous fish to Idaho in line with the agency goals. Two interrelated objectives are key to the project: 1) documentation of existing knowledge and 2) experimentation based on this knowledge to evaluate changes to hatchery operations.

## Adult Returns

In 1991, an estimated 3,810 summer chinook, 6,620 spring chinook and 56,960 summer steelhead adults crossed Lower Granite Dam, down substantially from the 1990 counts of 5,220, 17,600, and 131,240, respectively. Overall, returns of adult chinook salmon to Idaho racks in 1991 were down about 70% from 1990 estimates. Only the South Fork Salmon River trap (Mccall Fish Hatchery) intercepted more fish in 1991 than in 1990 (Figure 11). Steelhead returns to Idaho's racks were down 75% from the 1989-1990 returns.

Smolt-to-adult return rates for chinook released as smolts in 1988 ranged from 0.037% for Sawtooth Fish Hatchery spring chinook to 0.10% for McCall Fish Hatchery summer chinook to 0.19% for Dworshak National Fish Hatchery spring chinook.

The estimated return rate for steelhead released as smolts in 1987 at the Sawtooth weir was 0.32%.

## Post-Release Survival

PIT tag detection rates to Lower Granite Dam were variable for Idaho hatchery chinook salmon juveniles in 1991. Approximately 35% of McCall Fish Hatchery summer chinook juveniles were detected at Lower Granite Dam in 1991 whereas about 7% of Sawtooth spring chinook juveniles were detected. Clearwater satellite spring chinook released as presmolts were detected at rates from 3-8%.

Steelhead detections were quite high, between 60-80% for smolts released from Hagerman Fish Hatchery and Magic Valley Steelhead Hatchery.

## Separation of Hatchery and Wild Chinook

Project personnel mounted and pressed 771 adult chinook salmon scales in 1991 for Scale Pattern Analysis work. Work aimed at distinguishing hatchery from wild/natural adults is based on scale patterns and indicates that adult chinook trapped at the South Fork Salmon River weir can be classified with acceptable accuracy. Sawtooth-trapped chinook, however, cannot be separated, based on scale patterns. This information shows the need for marking hatchery fish to allow separation at the hatchery.

Experimentation Underway

1) Effects of size at release of steelhead juveniles on adult return rates; age-at-return; adult return sex ratios: Hagerman National Fish Hatchery. Experimentation began in 1989 and we expect our first full complement of results by 1993.

Effects of Marking/handling associated with the CWT program on survival of summer chinook salmon: McCall Fish Hatchery. Fish from brood years 1988-90 will be tested with adult returns becoming complete in 1993-1995.

Effects of reduced Rearing Density on survival of spring chinook salmon: Sawtooth Fish Hatchery. Brood year 1989-91 fish will be tested with adult returns becoming complete in 1994-96.

*Funding Source: USFWS - Lower Snake River Compensation Plan*

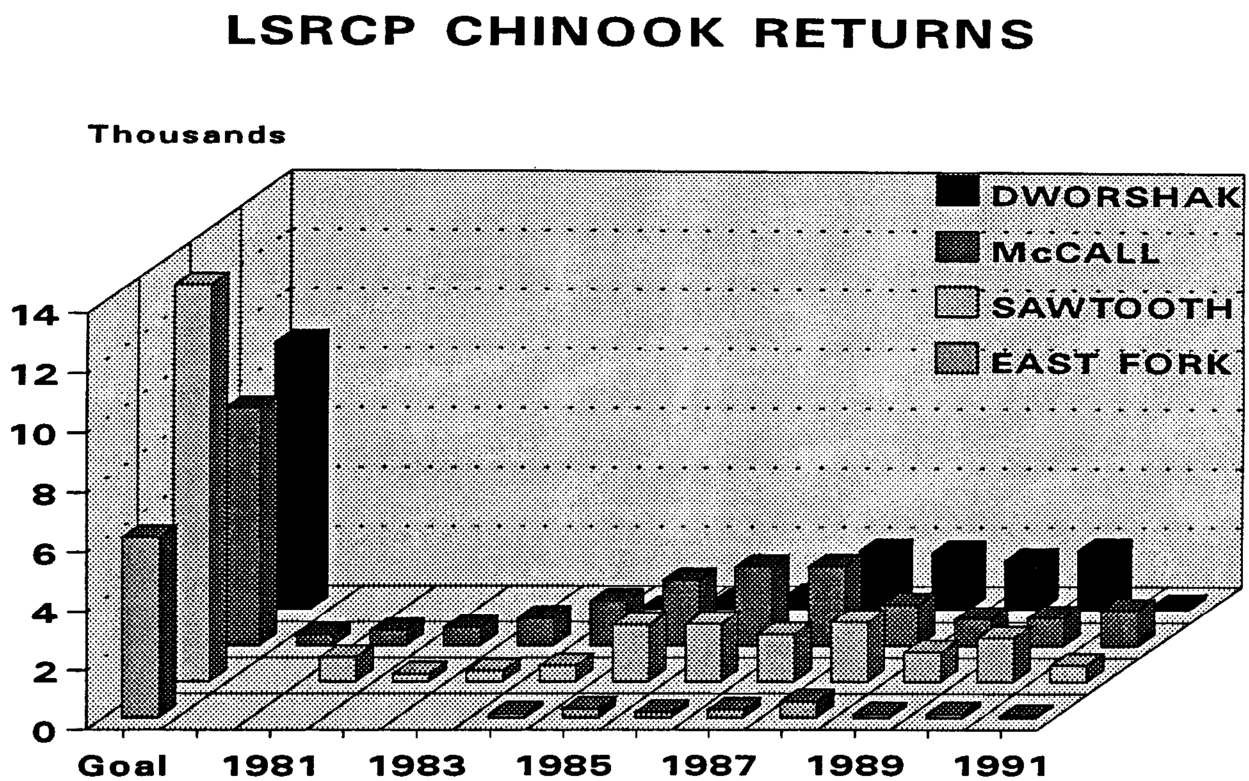



*Figure 11. Adult chinook salmon returns from Idaho LSRCP releases in relation to program goals.*

**LAKE AND RESERVOIR PRODUCTIVITY**

*Robert Dillinger, Senior Fishery Research Biologist*

The goals of the lake and reservoir evaluation project are to provide a limnological database for use in prediction of fish yields, and to establish protocols for continuing limnological data collection on a state-wide basis. These data will be used to determine the potential of each lake and reservoir in terms of fish yield and will provide managers with an initial baseline for evaluation of management decisions.

Additionally, habitat variables (such as temperature and dissolved oxygen) will be monitored throughout the summer and fall in selected reservoirs (Figure 12).

The Lake and Reservoir sampling program has provided specific technical support to Region 2 regarding their concerns about destratification of Lake Waha; to Region 3 concerning their efforts directed at aerating Lake Lowell; and to all regions regarding lake aeration and destratification.

This technical support includes an evaluation of the proposed methodology for Lake Waha; a collection of literature for Region 3; and a literature review concerning all aspects of lake aeration and destratification distributed to all Regional Managers. In addition, we are currently calculating potential yields for about 80 Idaho lakes and reservoirs using a number of empirical equations and data from Milligan et al. (1983). This includes an evaluation of a number of the above empirical equations in terms of the availability (and quality) of the data set. This data set is still undergoing analysis as to the value of the potential yields provided, prior to distribution.

*Funding Source: IDFG with Wallop-Breaux*

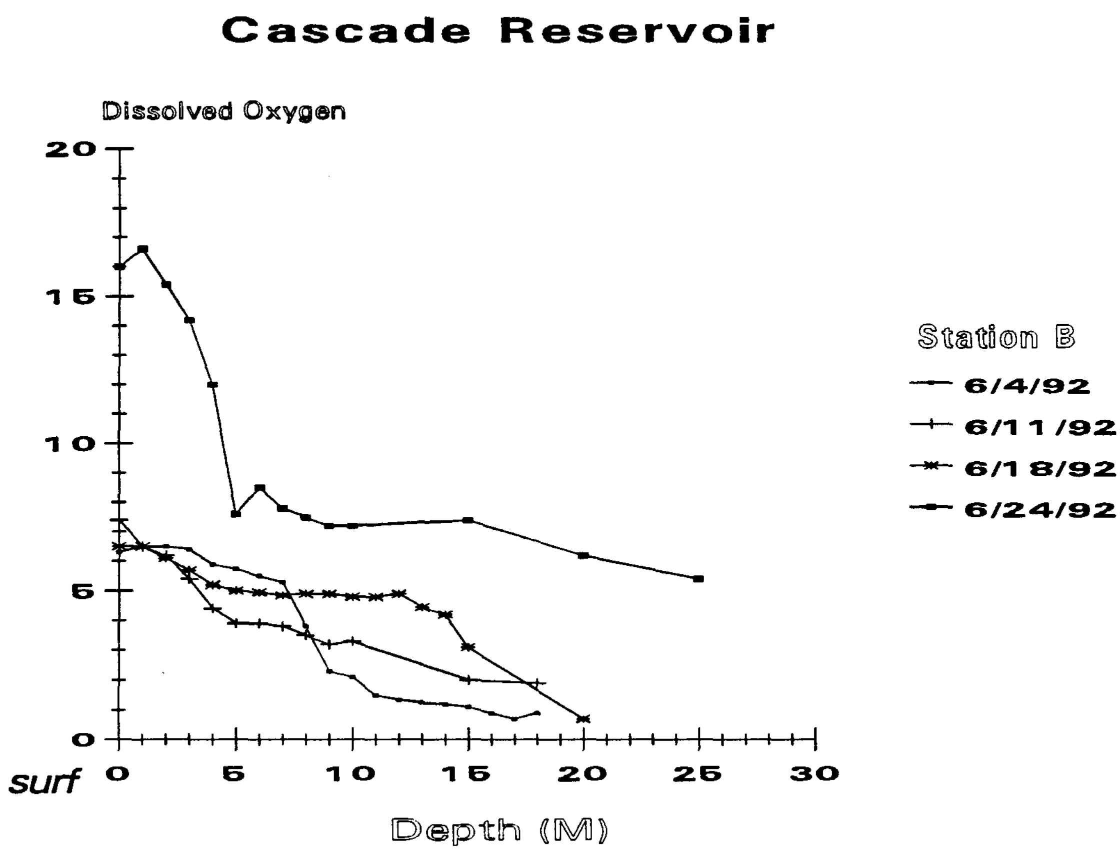



*Figure 12. Temporal changes in dissolved oxygen in Cascade Reservoir.*

# INTENSIVE EVALUATION OF CHINOOK AND STEELHEAD SMOLT PRODUCTION

*Russell B. Kiefer*
*Senior Fishery Research Biologist*

*Jerold N. Lockhart*
*Senior Fishery Technician*

The objectives of this project are to: 1) determine the number of chinook and steelhead adults needed to optimize smolt production; and 2) develop habitat mitigation accounting techniques based on increases in smolts. Two locations are being intensively studied to meet these objectives. Information from this research will be applied to parr monitoring streams statewide to develop escapement objectives and determine success of habitat enhancement projects.

Mean parr-to-smolt survival rates to Lower Granite Reservoir Pool for 1988-91 were 9% for age 0 chinook from both study areas, and 14% to 28% for age 2+ and older juvenile steelhead from Upper Salmon River and Crooked River, respectively.

Estimates of smolt survival from the study areas to Lower Granite Reservoir Pool based on PIT tag detections for run years 1988-91 were approximately 40% for age 0 chinook from both study areas and ranged from 35% to 64% for age 2+ and older steelhead from Upper Salmon River and Crooked River, respectively.

Wild/natural spring chinook smolts for both study areas arrived at Lower Granite Dam significantly later than the majority of all chinook smolts (predominately hatchery fish). Flow augmentation decisions should take into consideration that wild/natural spring chinook smolts arrive later at Lower Granite Dam than the more numerous hatchery smolts. The natural steelhead from both study areas arrived at Lower Granite dam during the latter part of the peak of wild/natural steelhead smolt run at Lower Granite Dam. All peaks in arrival at Lower Granite Dam corresponded with increases in flows.

A higher percentage of both age 0 chinook and age 2+ and older steelhead summer parr emigrate in the fall from Upper Salmon River (the higher elevation stream) than from Crooked River. Mean estimated percentages of the summer parr populations emigrating in the fall were 62% and 24% for age 0 chinook, and 58% and 19% for age 2+ and older steelhead from the USR and CR, respectively.

In all emigration periods monitored, both chinook and steelhead appeared to key in on the same stimuli for emigration, with sharp drops in water temperature and new moon periods being the major stimuli in the fall; and storm events being the major stimulus in the spring.

Off-channel ponds connected to CR with Bonneville Power Administration habitat improvement funds reared high densities of chinook parr. This strategy was recommended for rehabilitation of other streams degraded by dredge mining.

*Funding Source: Bonneville Power Administration*

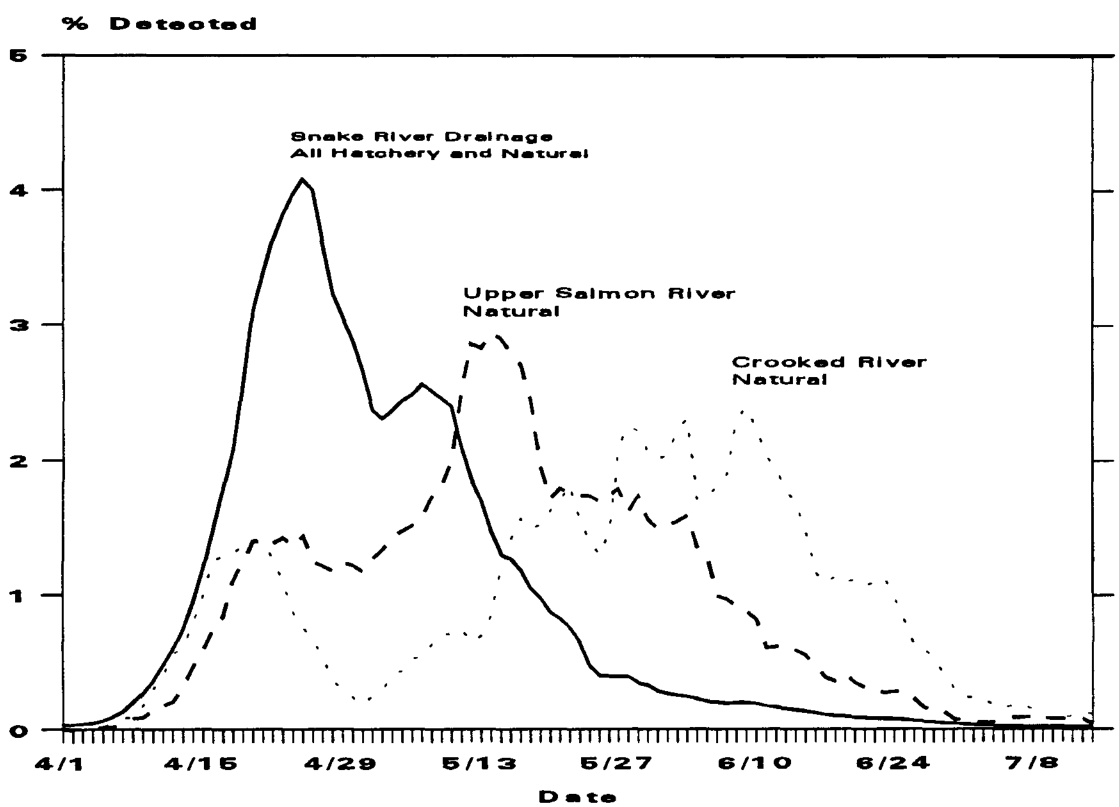



*Figure 13. Comparisons of wild/natural spring chinook smolt arrival timing at LGR Dam as compared to all hatchery and wild/natural smolt.*

## SOCKEYE SALMON RECOVERY
## OTOLITH MICROCHEMISTRY

***Bruce Rieman***
***Fishery Research Biologist***

***Deborah Myers***
***Senior Fishery Technician***

Numbers of anadromous sockeye salmon returning to Stanley Basin Lakes have declined to extremely low levels in recent years. The remaining Redfish Lake population has been listed as endangered. Despite the decline of anadromous fish, Alturas and Redfish Lakes still produce outmigrants that act as "smolts". It is possible that kokanee or a residual form of the sockeye may produce smolts, but no way was a distinguishing returning adults lineage available.

A new technique of otolith microchemistry was used to determine the parental origin of smolts leaving and anadromous adults returning to Stanley Basin lakes. The initial work was to determine whether the technique developed with anadromous brown trout and rainbow trout, would work with sockeye and kokanee.

We have used an electron microprobe at Oregon State University to measure the strontium and calcium content in the core of otoliths (earbone) from known kokanee and sockeye. We have found high levels of strontium in fish from anadromous parents, but not in fish from resident parents. We have also found a difference in their chemicals between fish from Alturas and Redfish Lakes. The method distinguished the origin of the four adults that returned to Red Fish Lake in 1991. The one female and two males had anadromous parents. The other male probably had anadromous parents. Preliminary analysis show at least one-third of 1991 outmigrant smolts from Redfish Lake had anadromous parents. these are the progeny of the last known natural spawners in 1989.

*Funding Source: Bonneville Power Administration*

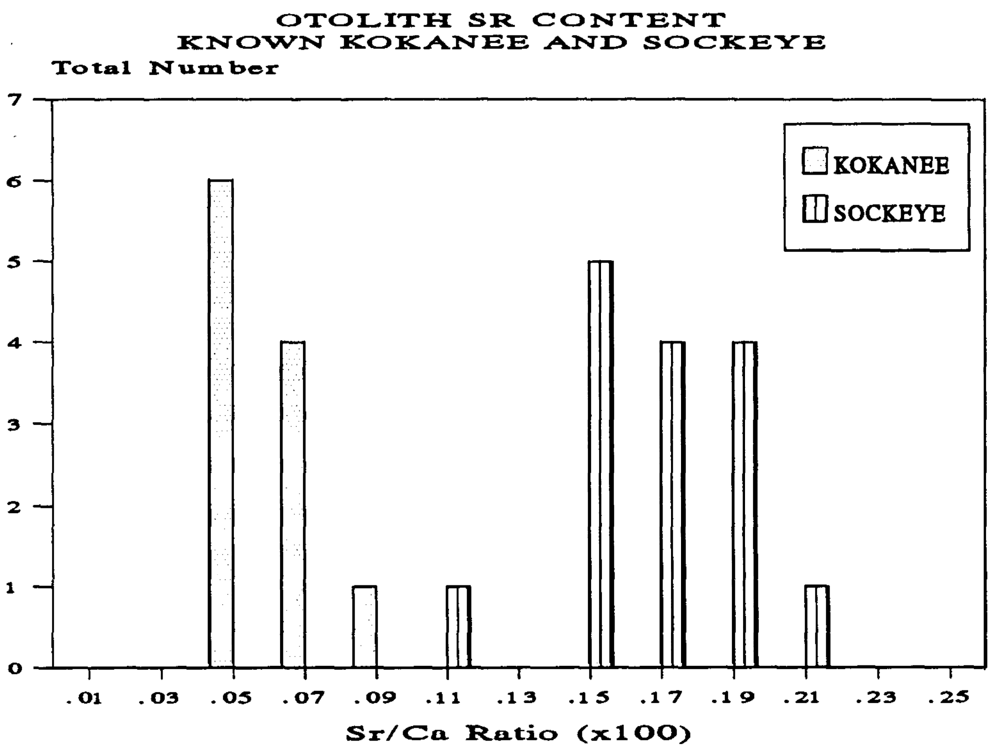

OTOLITH SR CONTENT
KNOWN KOKANEE AND SOCKEYE
Total Number
7
6
5
4
3
2
1
0
KOKANEE
SOCKEYE
.01
.03
.05
.07
.09
.11
.13
.15
.17
.19
.21
.23
.25
Sr/Ca Ratio (x100)

*Figure 14.*

## IDAHO SOCKEYE SALMON RESEARCH AND RECOVERY PROJECT

*Keith A. Johnson*
*Senior Fish Pathologist*

A captive broodstock program for sockeye salmon from the Stanley Basin, Idaho was initiated in May 1991 by IDFG and the Shoshone-Bannock Tribes through funding by Bonneville Power Administration. The anadromous form of Oncorhynchus nerka (sockeye salmon) from Redfish Lake was listed as endangered under the Endangered Species Act (ESA) by the National Marine Fishery Service in December, 1991 and a recovery plan which will utilize the captive broodstock is expected soon.

Broodstock sources for the Stanley Basin anadromous O. nerka captive rearing program include outmigrants from Redfish Lake and Alturus Lake and adult sockeye which returned to Redfish Lake in 1991. The goal of the program is to return $F_1$ generation presmolts of the anadromous form to these and other basin lakes which historically contained sockeye salmon. A portion of the outmigrants were trapped in 1991 and 1992, and converted onto a commercial semimoist ration. Current inventories include 994 Redfish and 222 Alturus Lake outmigrants. Growth and survival has been excellent and spawning is expected in 1992-94. The BY91 sockeye eggs from the single female and three males were divided between the facility at Eagle (IDFG) and NMFS Laboratory at Montlake in Seattle. Each site has about 935 fish. Milt from the three male sockeye in 1991 was cryopreserved and will be used in the captive broodstock program to enhance genetic diversity and known anadromy.

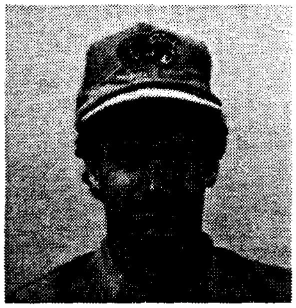
The main issue of the captive broodstock program is to enhance the anadromous form of O. nerka. Stock separation techniques are being researched using protein electrophoresis by NMFS, DNA fingerprinting by UI and WSU, and microchemical analysis of the otoliths by IDFG of outmigrants, returning anadromous adults, and resident O. nerka from Redfish and Alturus Lakes. The goal of this work is to be able to identify each individual prior to spawning to minimize crossing the anadromous with the resident form.

Areas of additional research and evaluation for a successful recovery program include determination of optimum size and time of release to reduce residualization, elevating lake productivity thorough fertilization, and evaluating the condition of natural spawning areas.

These efforts to restore Stanley Basin sockeye are designed to preserve this unique stock. The captive broodstock program may provide a means to bridge the period until the downstream migration mortality issues are resolved.

*Funding Source: Bonneville Power Administration*

**IDAHO SUPPLEMENTATION STUDIES**



*Eric Leitzinger*
*Senior Fisheries Research Biologist*

*Kurtis Plaster*
*Senior Fisheries Technician*

*Ed Bowles*
*Principal Fisheries Research Biologist*

**The project began in December 1989 with funding from the B o n n e v i l l e P o w e r Administration. The goal of the research is to determine if hatchery chinook salmon can increase naturally reproducing populations of spring and summer chinook salmon and to evaluate genetic and ecological impacts that hatchery salmon may have on existing natural populations.**

Thirty-one treatment and control streams in the Salmon River and Clearwater River systems have been selected for study. There are eight treatment and eight control streams in the Salmon River drainage, and twelve treatment and three control streams in the Clearwater River drainage.

Supplementation with parr, fall presmolt, and smolt life stages will be evaluated. These releases will be primarily off-site at multiple release points distributed throughout the treatment stream. Potential risks have been minimized by focusing the study in areas with ongoing hatchery programs and limiting "wild" production areas to control streams only.

Implementation began in 1991 with the collection of adult salmon at the hatchery weirs for supplementation broodstock and the collection of baseline juvenile chinook population estimates and redd counts.

Chinook and steelhead baseline population estimates were completed for all streams sampled by the Department and the Shoshone-Bannock tribes. The chinook populations were quite low, however, there were several surprises. Clear Creek (of the Middle Fork of the Clearwater River near Kooskia, Idaho) had one of the highest chinook estimates of any stream

(25,311 parr, 90% C.I. ± it was assumed there was not natural chinook production in Clear Creek). Parr were also found in upper White Sand Creek (above Big Flat Creek). These fish were most likely offspring from returning adults that resulted from fry releases into this area in the late 1980s. The North Fork Salmon River also had more juvenile chinook than expected (8,723).

*Funding Source: Bonneville Power Administration*

## STEELHEAD SUPPLEMENTATION STUDIES IN IDAHO RIVERS

*Alan Byrne*
*Fishery Research Biologist*

**The goal of this research is to establish a method for choosing a stock of steelhead that will be successful in establishing a viable self-sustaining population.** To accomplish this we will evaluate whether supplementation of steelhead in the Clearwater and Salmon rivers can be done without adverse effects on the abundance and productivity of the natural stocks.

The draft experimental design was completed by July 1, 1992 and classifies streams as wild, restoration, and natural areas. Wild rivers are managed exclusively for native fish production and are identified in the Idaho Anadromous Fish Management Plan. Restoration rivers are those rivers where the native stock has become extinct or reduced to very low abundances and the genetic risk of introducing other stocks of steelhead is low. These are the areas safe for supplementation experiments. Natural rivers are those areas where a viable but depressed stock of native or naturalized steelhead persists and genetic risk is high introductions.

In wild (e.g. Selway drainage) and augmentation rivers (e.g. John's Creek, South Fork Clearwater River) we plan to gather life history information and develop adult-to-adult survival estimates for baseline information to evaluate the success or failure of those programs. Short-term behavioral studies are proposed in artificial stream channels to gain insight on competitive interactions between native and hatchery fish. Because of the potential risks and uncertainties associated with supplementation, stocking in areas is not anticipated until these initial assessments are completed.

To protect native stocks, experiments using hatchery reared fish will be in restoration rivers only. In the restoration rivers (e.g. upper Salmon River) we plan to introduce fish from different brood sources document: (1) survival from egg-to-smolt; (2) smolt survival to Lower Granite Dam; (3) survival from smoltto-adult; and (4) compare the reproductive ability of returning spawners to produce progeny.

*Funding Source: Bonneville Power Administration*

## CREEL CENSUS SYSTEM

Thomas J. McArthur
Staff Biologist

The Creel Census System is a computer program which provides for the entry of data and the calculation of angler effort, catch rate, harvest, and yield estimates based on that data. It is designed to be used on an IBM compatible PC. A creel survey definition may be entered and stored in a database file, as well as both instantaneous counts of boat, bank, tube, and ice anglers and angler interviews of tackle used, hours fished and number and species of fish caught. Either uniform or nonuniform sampling may be used and boats may be counted or anglers in boats. Length, weight, species, tag number, and fin clip information for each fish may also be entered and stored. The calculation of estimated angler effort may be done based on the instantaneous count data and the average number of hours available for fishing in each day. Estimated overall catch rates and for up to eight fish species may be calculated based on the angler interview data of the number of anglers and the hours fished. Estimated overall harvest and for up to eight fish species may be calculated based on the calculated estimated effort and catch rates. All these calculations may be done on records restricted to a certain criterion, such as counts and interviews done between certain dates. Estimated overall yield and for up to eight fish species may be calculated based on average weight per fish from the length and weight data and the calculated estimated harvest. The distribution of tags and fin clips per fish species may be calculated based on the tag and fin clip data. An allometric growth equation for up to eight fish species may be calculated based on the length and weight data.

*Funding Source: IDFG with Wallop-Breaux*